Improved Monitoring, Analysis, and Prediction of High Impact Weather

University of Utah

2007-2010

Co-PIs John Horel, Jim Steenburgh, David Whiteman

Specific Goals

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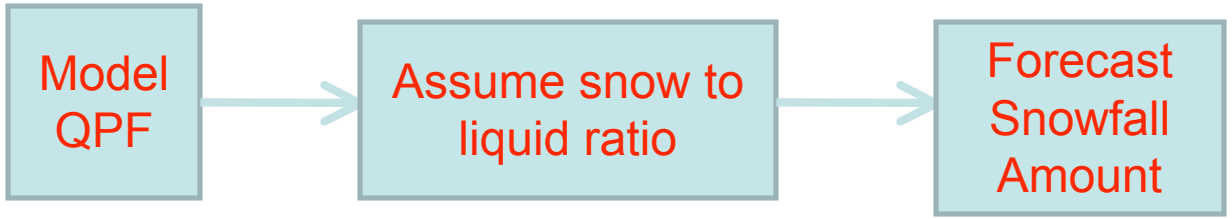
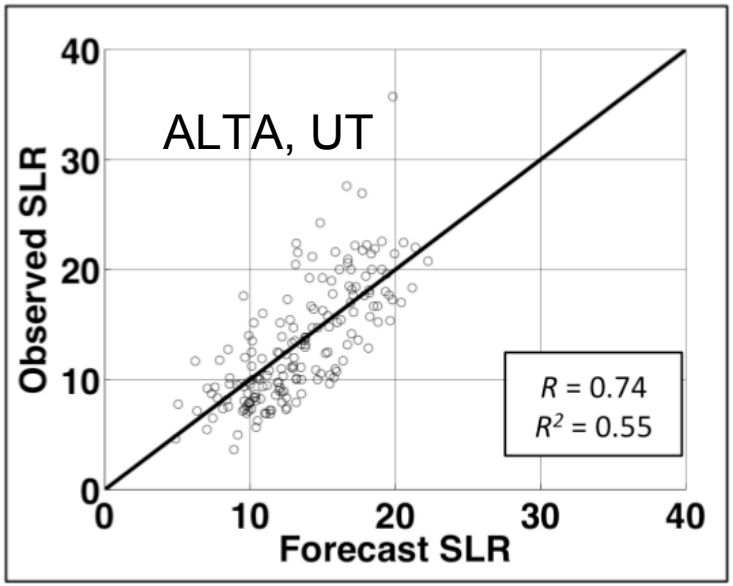
- Enhance understanding, analysis, and prediction of high impact weather influenced by the underlying terrain through data analysis, real-data model simulations, improved conceptual models and training materials
  - 3 M.S. Theses; 3 journal publications; 15 NWS related presentations & trainings
- Utilize effectively mesonet observations for a variety of applications
- Contribute to improvements in the Real Time Mesoscale Analysis and future Analysis of Record analyses
  - Estimating optimal distributions of surface observing stations

Applied Research: Alcott and Steenburgh (2009; *WAF*)

- Despite improvements in models, SLC WFO skill to predict snowfall amount in mountains has not improved during past decade



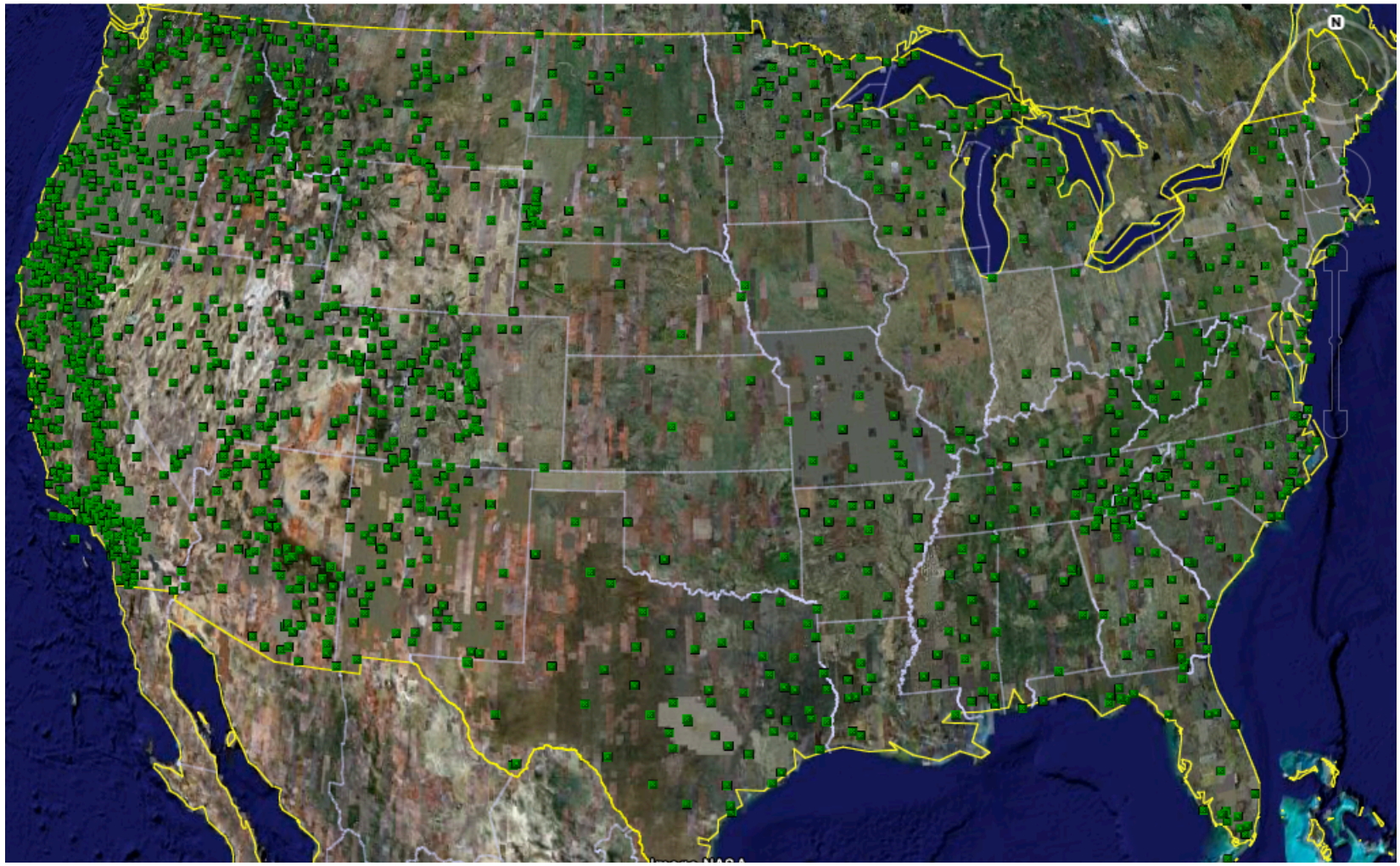
- Multiple linear regression used to predict snow-to-liquid (SLR) ratio
- Approach potentially can be applied elsewhere in Intermountain West



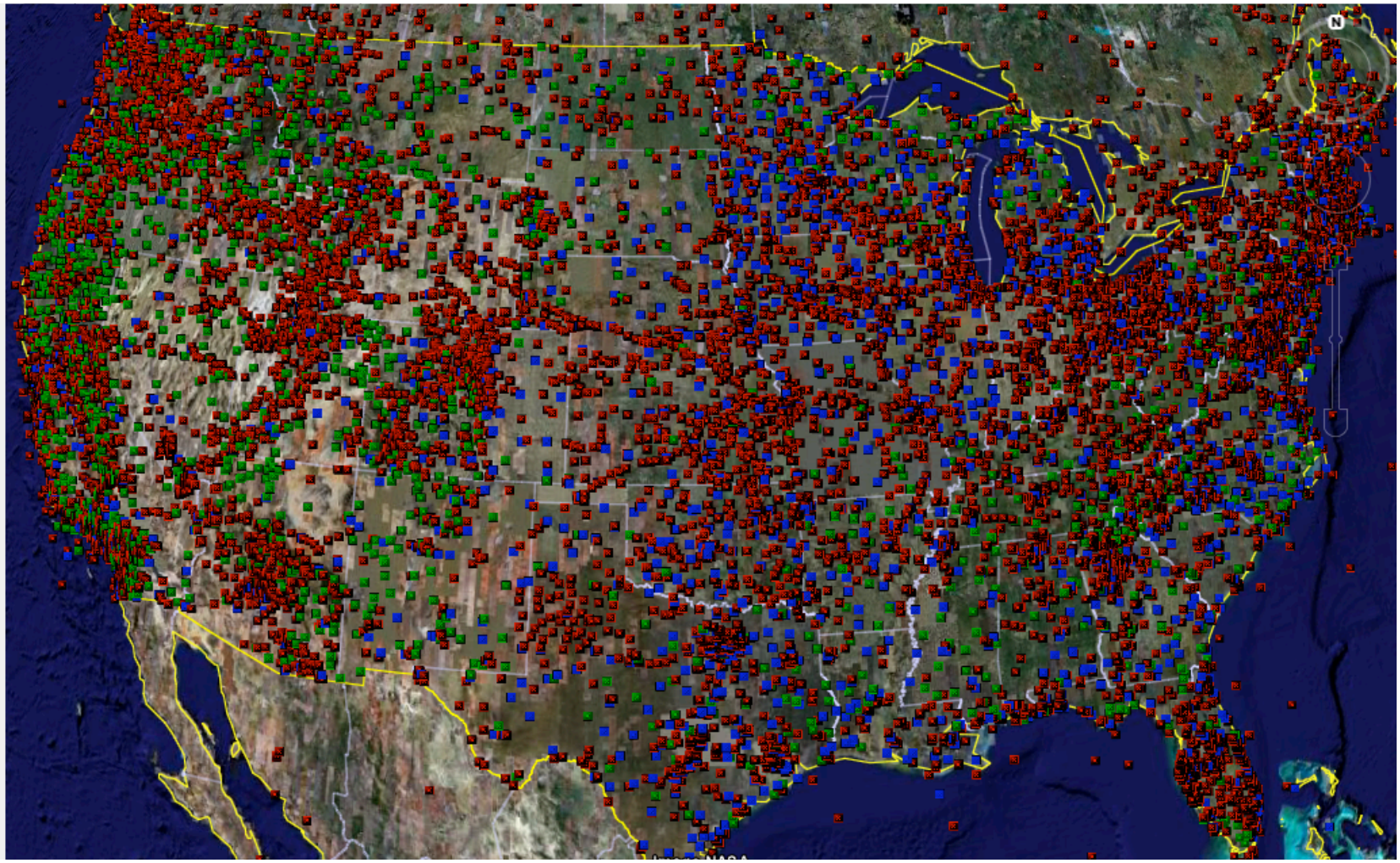
Improved utilization of mesonet observations

- MesoWest is a successful example of R&D supported by CSTAR
- MesoWest is more than one of the many data pipes to MADIS- MySql relational database of current and archived data, metadata, software, and web displays integral to WFO office and IMET operations
- Future of MesoWest?
  - Need plan to transition to operations, similar to business case developed for National Wildfire Coordinating Group for related ROMAN project
  - MesoWest has features relevant to design of future national "network of networks" recommended in NAS *From the Ground Up* report

RAWS: Part of the MesoWest Datapipe to MADIS



Mesonet Observations available via MesoWest/CWOP/MADIS (>15000)



Contributions to the RTMA and AOR surface analyses

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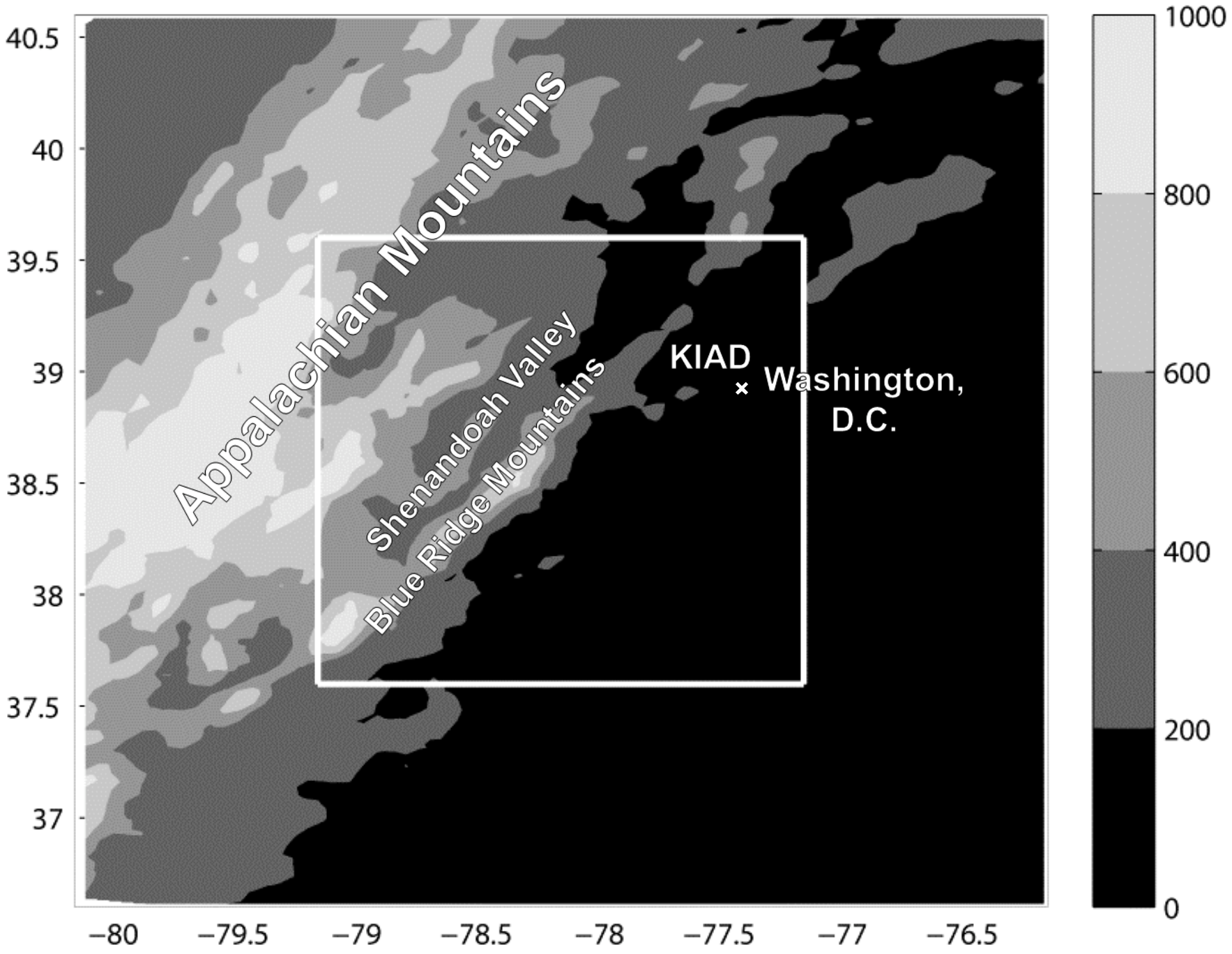
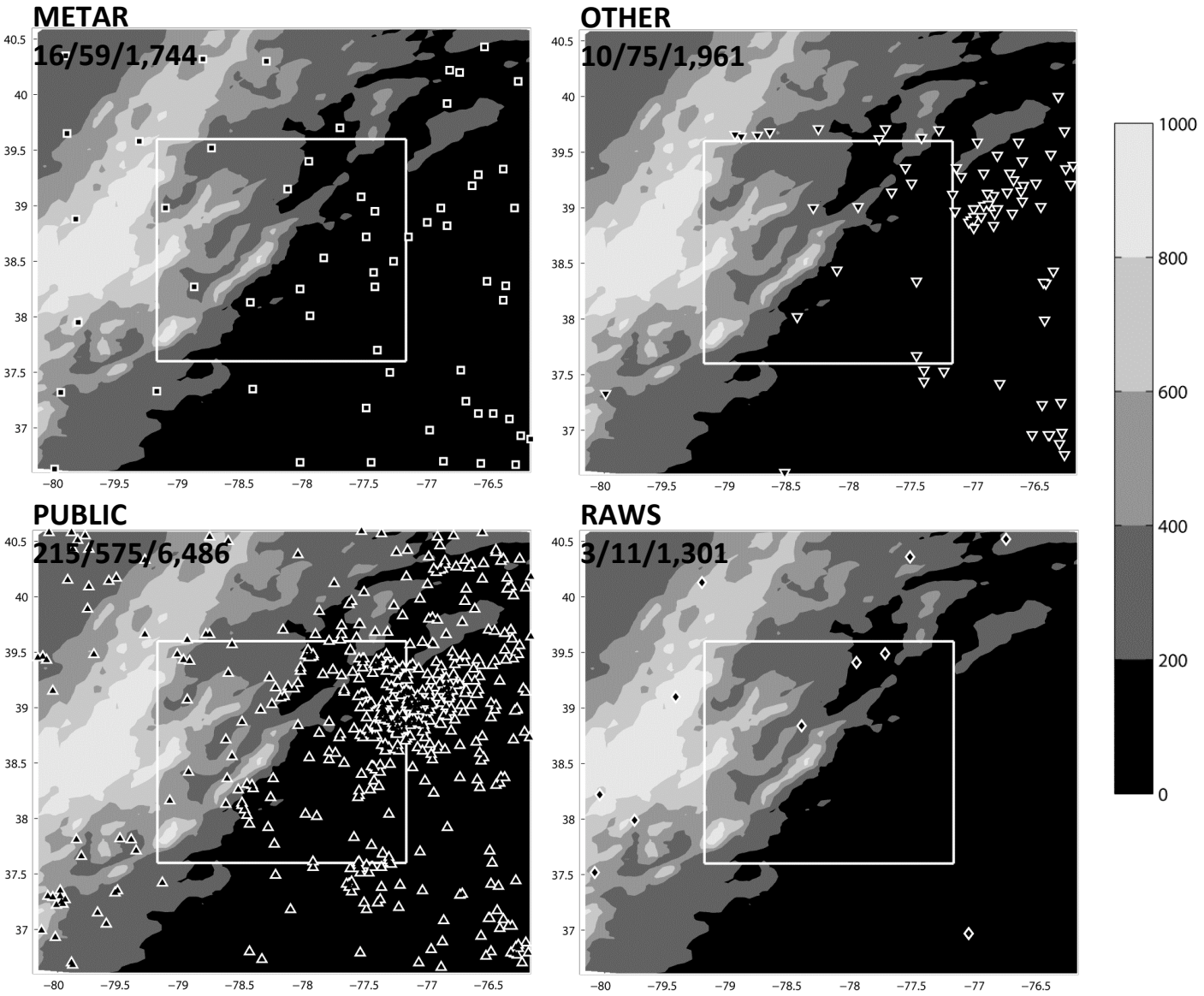
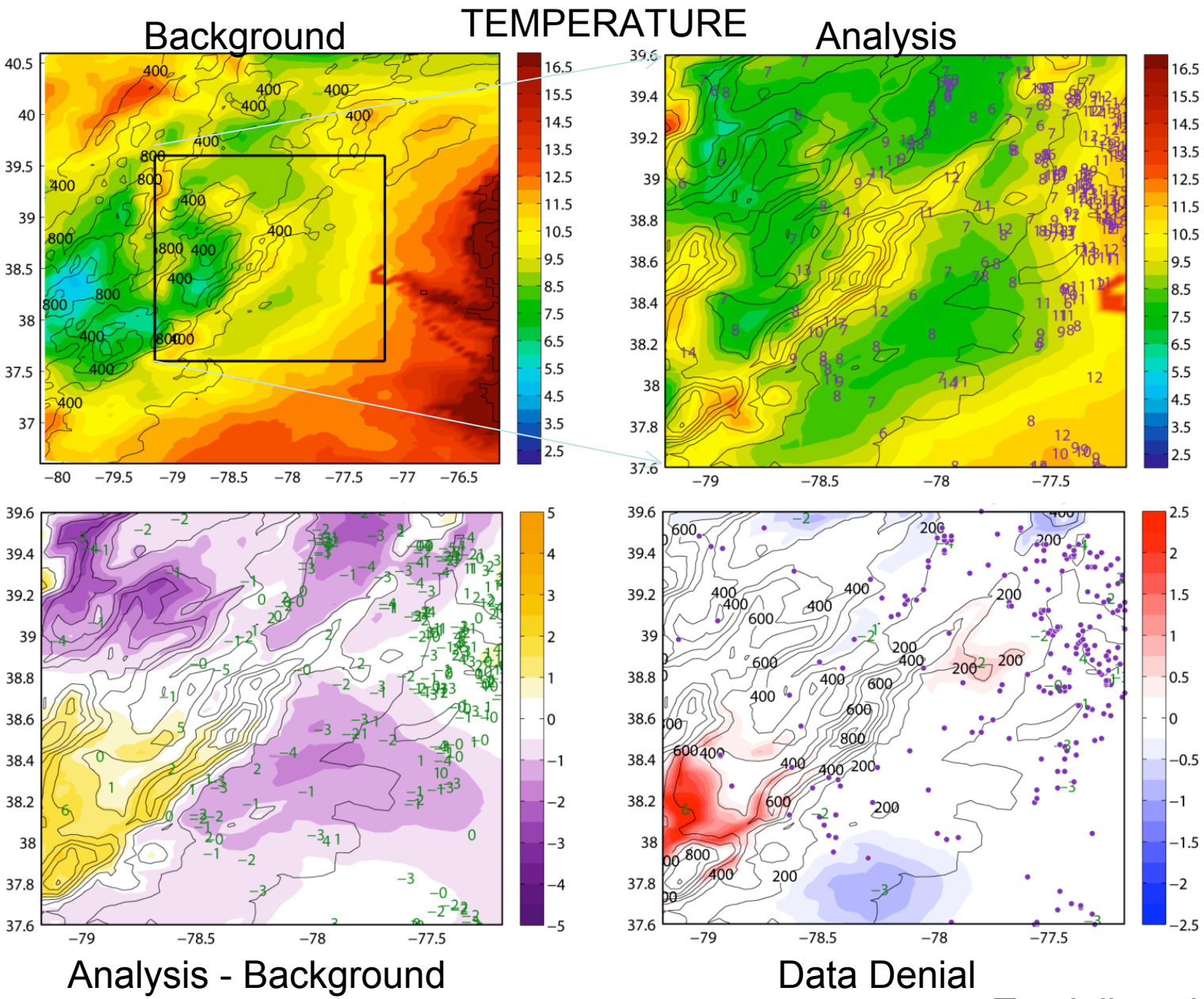
- Close coordination with RTMA developers at NCEP
- Graduate student Dan Tyndall ran RTMA analyses using the NCEP haze development computer as well as implemented a similar analysis system locally
- Our work led directly to RTMA modifications at NCEP
- Tyndall, D., J. Horel, M. Pondeca, 2009: *Sensitivity of Surface Temperature Analyses to Background and Observation Errors.* Submitted to *WAF.*
- Ongoing use of data denial methods to assess impacts of surface observations


40.5
40
39.5
39
38.5
38
37.5
37
−80
−79.5
−79
−78.5
−78
−77.5
−77
−76.5
1000
800
600
400
200
0
Appalachian Mountains
Shenandoah Valley
Blue Ridge Mountains
KIAD
Washington, D.C.

Observations Available to RTMA via MADIS/MesoWest in Shenandoah Region





Tyndall et al. (2009)

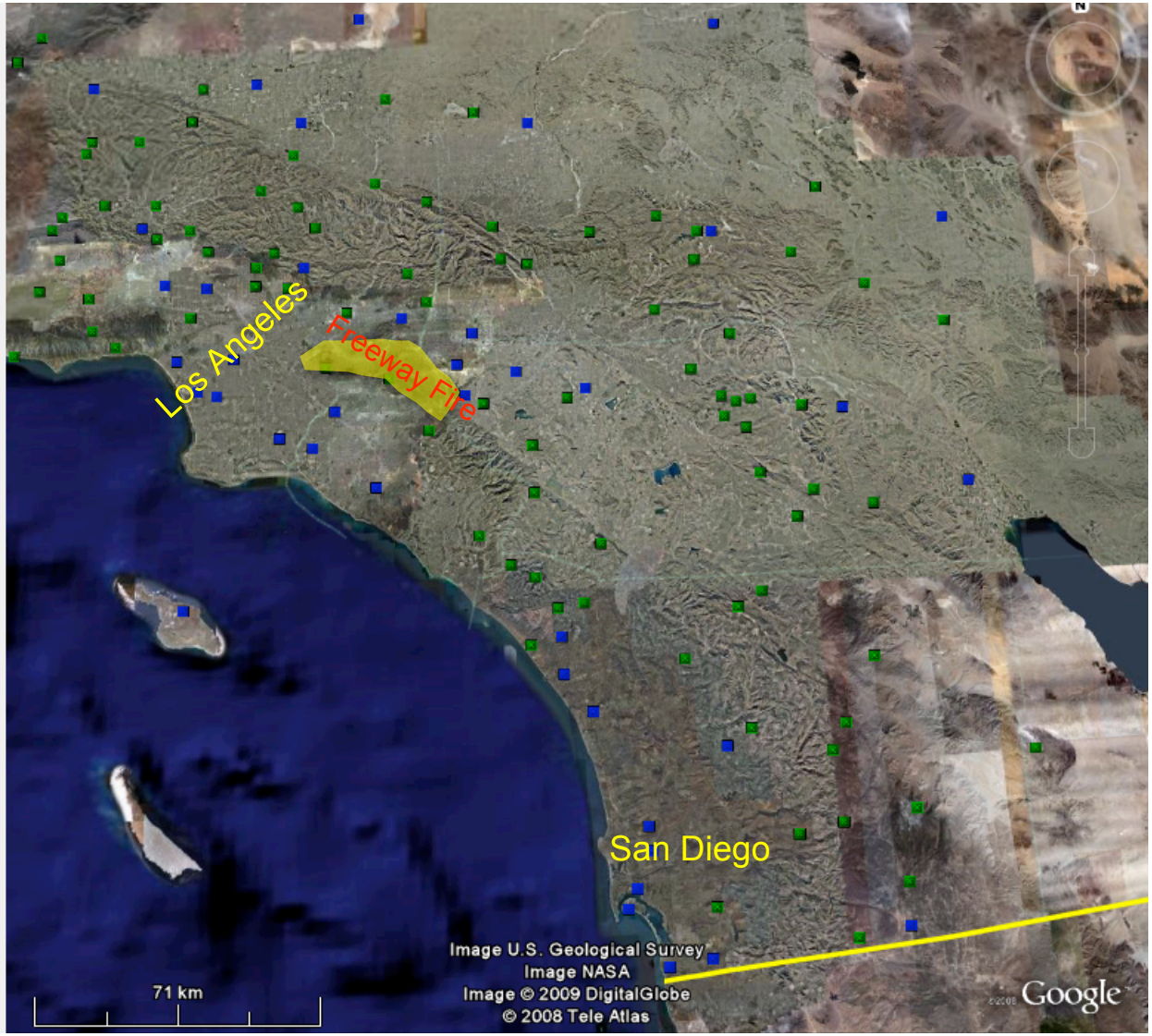
Impact of RAWS Observations

- Develop objective metrics to estimate the impact of RAWS observations on analyses of wind, temperature, relative humidity, and precipitation
- Assess the present distribution of RAWS stations for redundancies and gaps in the existing network
- Assess use of NWS/FAA observations for fire weather applications (e.g., compute fire danger indices)

Example

- Southern California during November 2008 (10-19 Nov.)
  - High impact: several large fires beginning on Nov. 15
  - Representative sample of NWS (~25) and RAWS (~60) stations
  - Wind (u,v) analyses only
- Compute control analysis using all NWS and RAWS stations for each hour
- Compute ~85 data denial analyses for each hour
  - Each observation is withheld in one data denial analysis while the remaining observations are used
- Compute statistics on the degradation of the analyses due to the removal of each station
  - Goal: is it possible to determine whether the analyses are more sensitive to removing some stations than others?

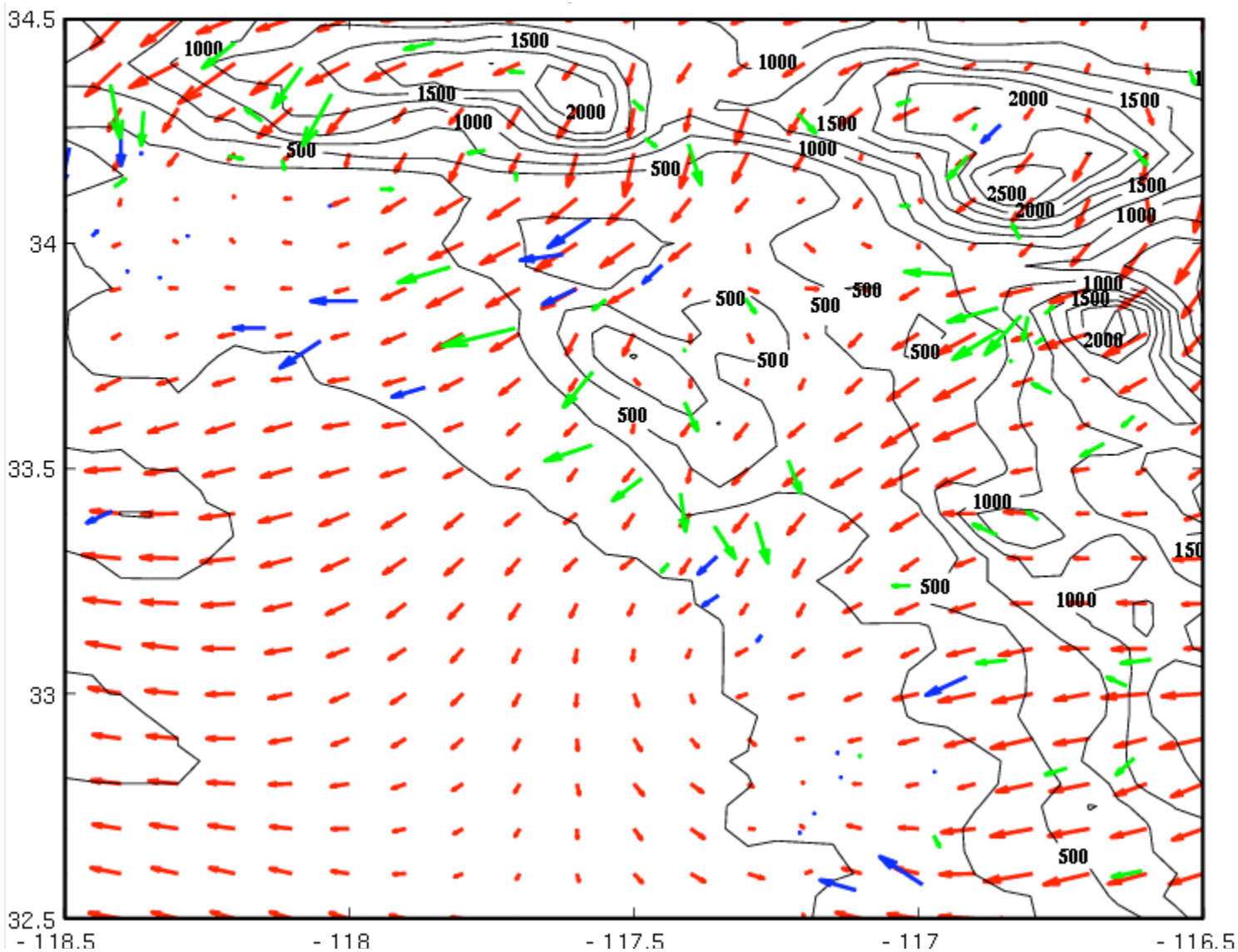
Southern California: ~25 NWS; ~60 RAWS



Freeway Fire complex:

- Nov. 15-19, 2008
- 30,000 acres
- Couple hundred homes/structures destroyed
- Firefighting costs >$16 million

Observed and Control Analysis Wind Vectors
1900 UTC Nov. 15, 2008



Control Analysis

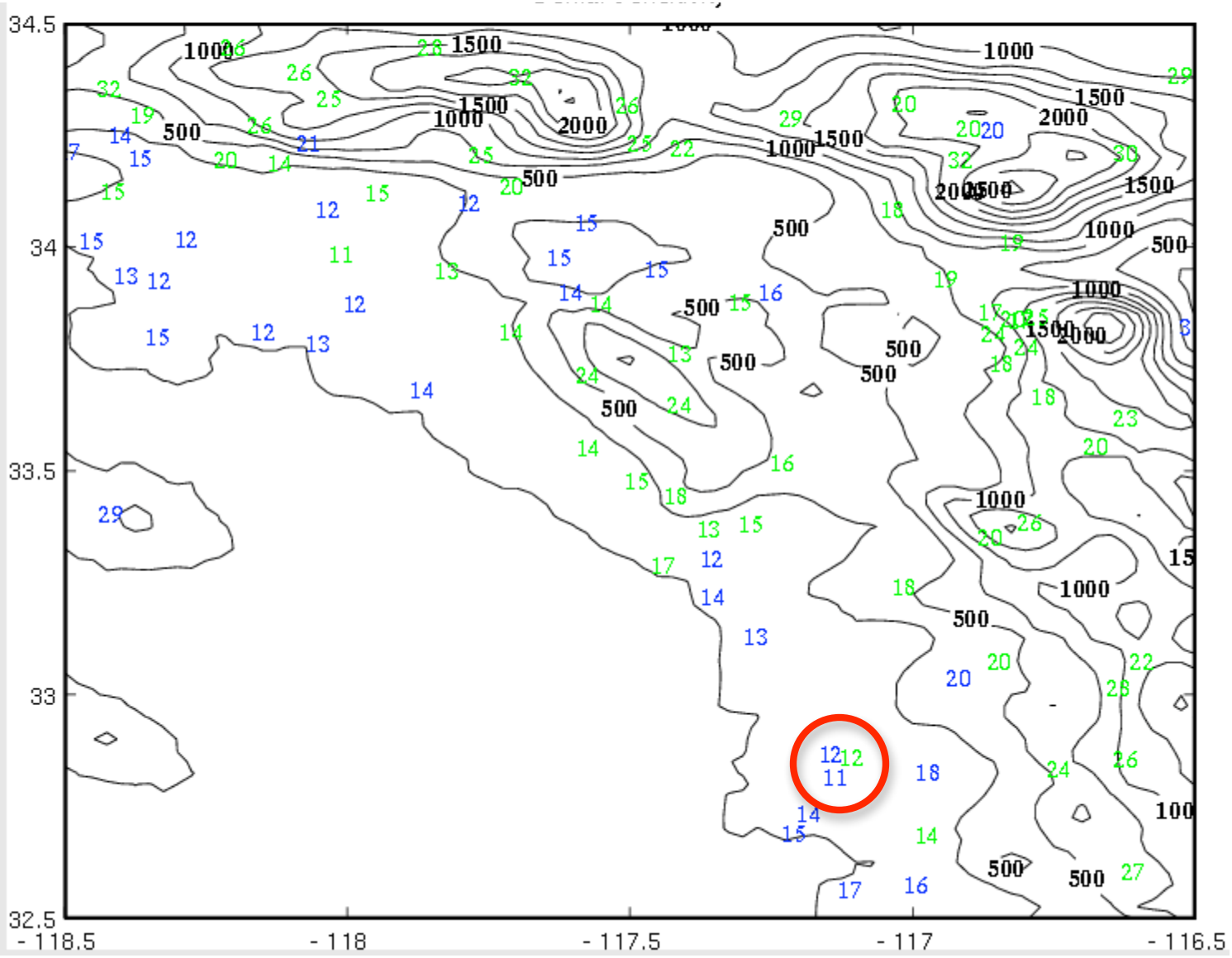
NWS

RAWS

Vector scale:

10 m/s

Analysis Degradation (%)



NWS

RAWS

Summary

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- Planning for national “network of networks” requires assessing impact and value of existing networks
  - Emphasis so far has been to generalize about the value of some mesonets relative to others
- Methodology developed to efficiently perform thousands of data denial experiments in order to develop statistics on the impact of removing selected stations
- More OSE & OSSE R&D would help to address the value of adding stations and networks
- Development of Analysis of Record critical for needs of WFOs as well as myriad applications, including GEOSS